Development of an operational assimilation system utilizing a Regional Chemistry Transport Model of Japan Meteorological Agency

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Japan Meteorological Agency (JMA) issues photochemical oxidant information to the public in Japan. The information is produced by using a regional tropospheric chemistry transport model (NHM-Chem) nested in a global tropospheric-stratospheric chemistry climate model (MRI-CCM2). To improve the forecast accuracy of NHM-Chem, we are developing a method to assimilate observed surface ozone concentrations using a nudging technique. We plan to adopt operationally the assimilation method in spring 2017. Hourly photochemical oxidant observations (preliminary data) are obtained from Atmospheric Environmental Regional Observation System of the Ministry of the Environment of Japan. As the quality of observational data to be assimilated is fundamentally important for performance of the assimilation system, we have also developed a real time quality control (QC) method. The QC method consists of an upper limit check with a threshold of 250 ppb, a spatial homogeneity check and time series gaps or spikes check. After the QC of the observations at each station, grid point values are calculated by averaging the observations in each model grid (20x20 km). These grid point data are used for data assimilation as well as its performance check. Our operational forecast system starts calculation at 04 japan standard time (JST) with initial time of 21 JST of the previous day. Therefore, it assimilates oxidant data observed in 21 ~ 03 hours local time and forecasts after that.

To check the performance of this new assimilation method, we compered forecasts of the surface ozone concentration with observations. The period of the validation was from March to September 2015. We validated forecast data (for the period of 04~20 JST), due to the assimilation, the estimated bias was reduced from 8.9 ppb to 6.6 ppb, RMSE was from 15.7 ppb to 13.7 ppb, and the correlation coefficient was improved from 0.61 to 0.69. The results showed the photochemical oxidant forecast accuracy became significantly better in the assimilation window and more than 3 hours the effect remained after the data assimilation ended.